# Spatial pattern of dominant tree species of the secondary monsoon rain forest in Lianjiang, Guangdong Province

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**Abstract**: Based on the summed dominance ratios of species in sample plots, the first three dominant species (*Litchi chinensis*, *Elaeocarpus sylvestris* and *Canarium album*) of the secondary monsoon rain forest of Mt. Royal Shoe in Lianjiang City, western Guangdong, were chosen for analyzing their spatial distribution pattern with the analysis methods such as frequency models of Poisson Distribution, Two Negative Items Distribution, Neyman Distribution, aggregate indexes, Taylor exponential equation and Iwao's equation modeling. The results showed that these three species distributed in the congregate spatial pattern. *Litchi chinensis* and *Elaeocarpus sylvestris* had the characteristic of basic congregate population and attractive characteristic between their plants. The patterns for *Canarium album* may change and become more evenly distributed with the increase of density. The overall species spatial pattern also depended on the conservation of the secondary monsoon rain forest besides it was affected by the species reproduction characteristics and its growing environment. The congregate spatial patterns of three dominant species showed that it is important to conserve forest urgent conservation of the forest.

**Key words:** Secondary monsoon rain forest; Spatial pattern; Summed dominance ratio; Aggregate index

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## Introduction[1]

In the tropical southern China, large area of the climax vegetation once distributed there, namely the tropical rain forest, but the area had decreased astonishingly (Zhou *et al*. 1996; Zen *et al*.1997). The kind of vegetation was not left in Leizhou Peninsula because of frequent interference of man's cutting activities and agricultural exploitation. Therefore, it is highly significant to carry out ecological studies on the several left patches of the secondary tropical monsoon rain forests in this area so as to understand their species components, structure and development of the plant associations. Spatial pattern analysis has become one of researches of population ecology (Krebs 1978; Peng 1989; Wang 1998). And we didn't find any research reports about the secondary monsoon rain forest in the north tropics. The spatial pattern analysis of tropical rain forest species offers better protection strategy about the north-tropical rain forests. The spatial patterns of dominant species also provide technical bases for setting up of a natural reserve to conserve the rare vegetation, especially for endangered plant populations in the forest.

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## Sites

Our research area is located at Mt. Royal Shoe, about 6 km east to Lianjiang City, Guangdong, with latitude 21°36′ and longitude 110°20′ and total area about 60 $hm^2$. The mountain has only two tops. The forest laterite originated from underneath volcanic rocks has high contents of organic material with pH 4.5-5.5 and the detritus about 3 cm thick. In sample plot annual mean temperature is 23.5 °C and mean annual precipitation is 1 758.8 mm.

According to the local records, Mt. Royal Shoe was the most important original genetic area for *Litchi chinensis*. The secondary monsoon rain forest at Mt. Royal Shoe was regenerated after the cutting down of trees in 1958. The age of the arbor layer trees should be about 10-50. There were 14 fern species, only 1 species (*Gnetum montanum* Markgr.) of Gymnospermae and 325 species of Angiospermae. The height of forest crown was about 12-16 m. The covering rate of arbor layer was 0.70-0.95. There were totally 47 arbor species among the arbor layers and the main species were as following: *Litchi chinensis* Sonn., *Canarium album* (Lour.) Rauesch., *Elaeopcarpus sylvestris* (Lour.) Poir, *Cinnamomum camphor* (L.) Presl, *Canarium pimela* Leenhoust, *Sapium discolor* (Champ. ex Benth.) Muell.-Arg., *Meliosma fordii* Hemsl., *Ormosia semicastrata* Hance, *Syzygium buxifolium* Hook. et Arn., *Symplocos hirta* (Hand.-Mazz.) Li, *S. summuntia* Buch, *Endospermum chinense* Benth., *Lannea coromandelica* (Houtt.) Merr., *Pithecellobium clypearia* (Jack.) Benth., *Evodia meliaefolia* (Hance) Benth., *Lindera megaphylla* Hemsl., *L.glauca*(Sieb. et Zucc.) Bl., *Cratoxylum ligustrinum* (Spach) Bl., *Callicarpa kwangtungensis* Chun, *Horsfieldia amydalina* Warbg., *Antiaris toxicaria* (Pers) Lesch., etc.. There were 177 shrub species. In the shrub layer, there were few seedlings of the dominant arbor species. The commonly found shrub species were *Casearia glomerata* Roxb, *Dasymaschalon rostratum* Merr. et Chun, *Psychotria rubra* (Lour.) Poir., *Ardisia quinquegona* Bl., *Lasianthus chinensis* Benth., *Glochidion eriocarpum* Champ., *Flacourtia indica* (Burm.f.) Merr., *Evodia lepta* (Spreng.) Merr., *Styrax japonicus* Sieb. et Zucc., *Pseudosasa amabilis* (Mecl.) Keng. f., *Ardisia japonica* (Hornsted) Bl.). In the herbaceous layer, the height was at 1-1.5 m and shade coverage was at 5% or so, *Pandanus tectorius* Sol. prevailed over all other species; and other often-presenting herbaceous species were *Lophatherum gracile* Brongn., *Carex cryptostachys* Brongn and so on. There were 79 herbaceous species in the forest. The ferns were mainly *Adiantum capillus-veneris* L., *Colysis digitata* (Bak.) Ching, *Hemigramma decurrens* (Hook.) Cop., *Nephrolepis auriculata* (L.) Triman, *Pteris ensiformis* Burm., *Dicranopteris dichotoma* (Thunb.) Bernh., etc.. 24 vine species were recorded, and were mainly *Piper chinense* Miq., *Tetracera asiatica* (Lour.) Hoogl., *Smilax glabra* Roxb., *Millettia lasiopetala*(Hay.) Merr., *Byttneria aspera* Colebr., *Calamus egregius* Burret., *Lygodium microphyllum* (Lav.) R.Br., *Diploclisia glaucescens* (Bl.) Diels, etc..

## Research methods

### Plot survey

Among the secondary monsoon rain forest, 30 plots were set up evenly with each square area of 20 m×20 m. We recorded every tree's height and diameter at breast height, plant number of each species as well as the conditions of growing site.

### Summed dominance ratio ($S_{DR2}$)

The coverage ratio means the result of a species total section area at height of breast divided by all species section area at the same height in a plot.

$$S_{DR2} = (D+C)/2 \times 100\% \quad (1)$$

Where:

*D*-- Density ratio; *C*-- Coverage ratio.

The results of equation (1) (Li *et al*. 2000) produce all species $S_{DR2}$ values with the input of the plot data. The first three largest values of the average species $S_{DR2}$ are regarded as dominant species in further spatial pattern analysis.

### Determination of spatial patterns

The data were treated with the frequency models of Poisson distribution, Two Negative Items Distribution and Neyman Distribution. The distribution pattern (Taulor 1984) was obtained with following methods.

Aggregate coefficients calculation (Pielou 1985; Krebs 1978; Taulor 1984):

Distribution coefficient (*C*):

$$C = S^2 / \overline{X} \quad (2)$$

Aggregate index (*I*):

$$I = S^2 / \overline{X} - 1 \quad (3)$$

Distribution index ($I_s$):

$$I_s = n(\sum X_i^2 - N)/\{N(N-1)\} \quad (4)$$

Cassie R.M.Index ($C_A$):

$$C_A = (S^2 - \overline{X}) / \overline{X}^2 \quad (5)$$

Average clump Index ($X^*$):

$$X^* = \overline{X} + S^2 / \overline{X} - 1 \quad (6)$$

Iwao's equation:

$$X^* = a + b\overline{X} \quad (7)$$

Taylor Index (lg*a*): as Taylor exponential equation is $S^2 = a\overline{X}^b$, then we obtain the value of lg*a* as followed:

$$\lg S^2 = \lg a + b \lg \overline{X} \quad (8)$$

Where:

$X_i$ -- the number of plants of one species in No.*i* plot;

$\overline{X}$ -- the average number of plants of one species in all plots;

$N$ --the total number of plants of one species;

$S^2$ –the square deviation of numbers of a species in all plots;

*a, b* --the linear constants between $X^*$ and $\overline{X}$.

The judgment of spatial patterns of species could be figured out with above indexes as showed in Table 1. In equation (8), when lg*a*=0 and *b*=1, we can confirm that the species population is always congregate in any density; when lg*a*>0 and *b*>1; when lg*a*<0 and *b*<1, the spatial distribution becomes more and more evenly with the increasing of its density.

We grouped the data into 5 groups with data from 6 plots. In each group we obtained the spatial pattern by the Taylor exponential equation and Iwao's equation for the dominant species of the associations and then marked correlation with their ideal equations.

**Table 1. Determination of spatial patterns of species**

| Spatial patterns | $C$ | $I$ | $I_\delta$ | $C_A$ | $X^*/\overline{X}$ | $\beta$ |
|---|---|---|---|---|---|---|
| Random | $C\equiv1$ | $I\equiv0$ | $I_\delta\equiv1$ | $C_A\equiv1$ | $X^*/\overline{X}\equiv1$ | $\beta=1$ |
| Even | $C\equiv0$ | $I<0$ | $I_\delta<1$ | $C_A<0$ | $X^*/\overline{X}<1$ | $\beta<1$ |
| Congregate | $C>0$ | $I>0$ | $I_\delta>1$ | $C_A>0$ | $X^*/\overline{X}>1$ | $\beta>1$ |

## Results

### Comparison of average $S_{DR2}$ of the dominant species

According to the plot data, we chose the species with $S_{DR2}\geqslant6\%$ in each plot to obtain the species average $S_{DR2}$ in 5 plots, then we got the first three species with largest average $S_{DR2}$, which were *Litchi chinensis*, *Elaeocarpus sylvestris* and *Canarium album* recorded in Table 2. Therefore, those trees had dominated in the secondary monsoon rain forest of Mt. Royal Shoe. *Litchi chinensis* as the first main species dominated in 25 plots among 30 surveyed plots and *Elaeocarpus sylvestris* was investigated in 5 plots in the same way. They both had the characteristic of basic congregate population and attractive characteristic between their plants. *Canarium album* was an important companion species in the forest.

### Spatial pattern of the populations of dominate species

Frequency modeling result of three dominant species showed that all these population's spatial patterns belonged to the model of Two Negative Items Distribution. Based on data of the 30 plots, we obtained aggregate indexes according to the equations of (2)-(7) as showed in Table 3. The values of Distribution Coefficient ($C$) of *Litchi chinensis*, *Elaeopcarpus xylvestri* and *Canarium album* all were more than 1 at the notable level of $X^2_{0.05}$ with $X^2$ test; their Aggregate Indexes ($I$) were all more than 0; and their Distribution Index ($I_\delta$) all larger than 1 at the notable level ($F_0>F_{0.05}$) of the random deviation test with formula as $F_0=\{I_\delta(\sum X_i-1)+n-\sum X_i\}/(n-1)$; $X^*/\overline{X}$ were over 1. So whichever aggregate index was marked, the spatial patterns of these three dominant species fit themselves into the model of Two Negative Items Distribution, namely congregate distribution. It was clear that both methods of aggregate indexes and comparison of frequency modeling reached the same result. We found that both methods could be applied to judge the spatial patterns of dominant trees in the secondary monsoon rain forest in north-tropical areas as important reference.

**Table 2. Comparison of average $S_{DR2}$ values of main species**

| Species | Average $S_{DR2}$ (%) | Number of plots | $x\sigma_{n-1}$ of $S_{DR2}$ |
|---|---|---|---|
| *Litchi chinensis* | 52.59 | 30 | 23.40 |
| *Elaeocarpus sylvestris* | 27.13 | 12 | 13.76 |
| *Canarium album* | 21.00 | 18 | 9.35 |

**Table 3. Aggregate indexes of spatial patterns for three main trees**

| Species | $C$ | $I$ | $I_\delta$ | $C_A$ | $X^*/\overline{X}$ | Spatial patterns |
|---|---|---|---|---|---|---|
| *Litchi chinensis* | 9.1294 | 8.1294 | 1.2262 | 0.2336 | 1.2334 | Congregate |
| *Elaeocarpus sylvestris* | 7.9732 | 6.9732 | 1.7044 | 0.7254 | 2.4508 | Congregate |
| *Canarium album* | 5.2504 | 4.2504 | 1.6130 | 0.6304 | 1.6304 | Congregate |

In Table 4, both *Litchi chinensis* and *Elaeopcarpus sylvestris* ($\lg a>1$, $b>1$ and $b>1$) were congregate at all densities and correlated with their densities. *Canarium album* ($\lg a<0$ and close =0, $b>1$ and $b>1$) also means congregate distribution of its population. It is estimated that their species may become more evenly distributed with the increasing of its density.

**Table 4. Modeling of Taylor exponential equation and Iwao's equation**

| Species | Taylor exponential equation | | Iwao's equation | |
|---|---|---|---|---|
| | Equation | Correlated index | Equation | Correlated index |
| *Litchi chinensis* | $S_2=1.824\,3\,\overline{X}^{1.434\,1}$ | 0.908 2** | $X^*=6.961\,1+1.029\,2\,\overline{X}$ | 0.915 9** |
| *Elaeocarpus sylvestris* | $S_2=1.300\,8\,\overline{X}^{1.632\,8}$ | 0.937 6** | $X^*=0.945\,0+1.386\,5\,\overline{X}$ | 0.925 2** |
| *Canarium album* | $S_2=0.995\,2\,\overline{X}^{1.722\,7}$ | 0.912 8** | $X^*=-0.203\,5+1.481\,2\,\overline{X}$ | 0.915 3** |

**Notes**: **--very notable (0.01) correlation between $S^2$ and $\overline{X}$ or $X^*$ and $\overline{X}$.

## Conclusions

The results that 3 dominant tree species in building the forest of Mt. Royal Shoe in Lianjiang, Guangdong met the spatial pattern of Two Negative Items distribution meant the wide applicability of this spatial pattern in depicting the distribution of species population (Wang 1998). The frequency comparison could not provide more information about the reasons in forming its spatial pattern.

Taylor exponential index and Iwao's equation gave more reasonable explanation on the spatial pattern of dominant species in the north-tropical secondary rain forest. *Litchi chinensis, Elaeopcarpus sylvestris* and *Canarium album* showed that they were congregate. Among them *Litchi chinensis* and *Elaeopcarpus sylvestris* were congregate at any density and correlated with their densities ; *Canarium album* (lg$a<0$ and close=0, $b>1$ and $b>1$) also meant congregate of its spatial pattern, but it maybe become more evenly distributed with the increasing of its density.

All these three species bear heavy edible fruits that cannot be easily distributed evenly by the means of nature forces such as wind and water. This suggests that the different patches of the same species may have potential genetic diversity with its congregate population spatial pattern.

The spatial pattern of a population is affected by many factors, e.g. the diversity of forest, fruiting and seed distributing habit of species, and growing conditions as well as interference from man's activities (Hubbell *et al*. 1983). We did find and record a few of the seedlings and small plants. Thus, we are sure that the spatial pattern of trees in the north-tropical secondary monsoon rain forests was correlated with its conservation status besides other natural ecological proceeding factors.

The dominant species spatial patterns provide technical bases for conserving the rare vegetation, especially for the endangered species populations, such as *Litchi chinensis*, etc..

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# (Chinese abstracts attached to Journal of Forestry Research, Vol. 12, No.2 (2001))

林木遗传工程及木质素的生物合成调节/唐巍， Janet Ogbon， Aquilla McCoy (North Carolina State University, Forest Biotechnology Group, Centennial Campus Box 7247, Raleigh, NC 27695-7247, USA) //Journal of Forestry Research.-2001,12(2).-75-83

林木遗传工程有利于保存林木遗传资源，改善全球气候，减轻自然林的过度采伐和满足人类日益增长的林木产品需求。控制林木真菌、病毒病、虫害和杂草的遗传工程方法正被广泛地研究和应用。尽管转基因林木的历史不长，种类不多，但它有广泛的应用前景。目前，抗除草剂基因、抗虫基因以及和木材质量相关的基因已被分离并应用于林木遗传工程。植物分子生物学和基因组学中的新技术使得高效林木遗传改良成为可能并将促进这些技术的商业化应用。木质素的应用已有一百年的历史，但木质素生物合成的全过程并不完全清楚。有关松树自然突变体和转基因林木的最新研究结果表明，木质素的生物合成是一个可以调节的过程。这些发现对完善木质素的生物合成途径、加深对木质素前体生物合成途径的理解和通过遗传工程改善木材质量有促进作用。本文综述了林木遗传工程在这些领域中取得的一些进展。

关键词：转基因树；遗传工程；木质化；基因表达调节

优良红松坚果型优树的选择方法/杨凯（黑龙江省林业科学研究所，哈尔滨 150040），谷会岩，李春英，杨逢建（东北林业大学森林植物生态开放研究实验室，哈尔滨 150040）//Journal of Forestry Research.-2001, 12(2).-84-88

于 1988-1998 年对长白山、小兴安岭和完达山地区天然红松林以及黑龙江省鹤岗地区人工红松林结实量进行了实地调查和测定。根据调查和测定数据，对红松结实特征，包括结实量、球果长度、球果数量、出种率，种子千粒重、种子产量、种子大小、种子空实率、球果虫害率、结实指数等，进行分析方差分析、多重比较和逐步回归，得出各项结实因子对结实量的贡献率，将球果长度、千粒重和出种率确定为优树选择的重要指标，然后采用加权系数法确定红松坚果型优树，并制订出天然红松林坚果型优树标准和红松人工林坚果优树标准。本项研究为建立红松坚果园选择优树提供了方法和标准。

关键词：红松；坚果型优树；选择方法

长白山北坡植物群落间物种共有度的海拔梯度变化/邓红兵，郝占庆，王庆礼（中国科学院沈阳应用生态研究所，沈阳 110015）//Journal of Forestry Research. -2001, 12(2). -89-92

应用梯度格局法在长白山北坡海拔 700-2 600 m 之间每 100 m 设置一样地，共计 20 块样地，应用 Jaccard 指数，对植物群落间物种共有度的海拔梯度变化进行了分析。不同海拔群落间的共有度，无论以哪一层次的植物种来表达，基本都以与其最相邻海拔的群落之间为最高。相邻海拔群落的不同层次物种间的共有度变化存在相似性和相异性；但如相邻海拔的两个群落属于不同植被类型，其共有度则较低。群落间物种共有度的峰值与谷点反映了植被的海拔梯度格局，且灌木种的物种更替在这些地段具有非常明显的规律。在同一海拔差群落间的共有度数值都非常接近，并均随着海拔差的增加呈明显的下降趋势，表明群落各层次物种的构成有很大的相关性。

关键词：长白山；共有度；植物群落；海拔梯度

大小兴安岭森林植被交错区在全球气候变化研究中的科学意义/国庆喜（东北林业大学森林资源与环境学院，哈尔滨 150040）//Journal of Forestry Research, 12(2).-93-96

大小兴安岭是我国纬度最高的地区，也是我国近百年来温度增加最明显的区域。大小兴安岭森林植被交错区位于东经 123°～128°，北纬 48°～53°之间。作为温带针阔叶混交林向寒温带针叶林的过渡区域，在全球变化研究中占有重要地位。本文对该交错区的地理位置、地形地貌、气候梯度、土壤类型、植被类型等进行了论述。

关键词：交错区；全球气候变化；大兴安岭；小兴安岭

长白山北坡林线分布趋势的研究/张扬建，代力民（中科院沈阳生态研究所，沈阳 110015），潘洁（江西农业大学，南昌 330045）//Journal of Forestry Research. -2001, 12(2).-97-100

为了揭示高山树线随着气候变化而变化的现象，对长白山的高山树线变化趋势进行了研究。根据长白山北坡地区的气象数据，重点调查了（对树线有最大限制作用）一月平均气温和年积温。并在岳桦林与高山苔原之间的交叉带内测出岳桦的地径及样方内岳桦株数。根据地径与年龄有线性关系，地径可以用来代替年龄。结果表明岳桦林年龄随着海拔的上升而降低。近些年长白山北坡的气温在渐渐上升，因此导致了高山树线的上升。

关键词：树线；温度；海拔；气象数据

广东廉江次生季雨林主要建群种空间分布/韩维栋，高秀梅，李林锋（湛江海洋大学园林系，广东湛江 524088），卢昌义（厦门大学环科中心，福建厦门 361005）//Journal of Forestry Research.-2001,12(2).-101-104

根据所调查样方的树种综合优势比值，对广东西部(粤西)廉江谢鞋山次生季雨林最重要的三个建群树种，进行了空间格局分析。分析方法采用了 Poisson 分布、负两项分布、Neyman 分布的频次比较模型和聚合度指数测定以及 Taylor 指数和 Iwao’s 方程模拟。结果表明这三个建群种均符合聚集分布。

荔枝（*Litchi chinensis*）和山杜英（*Elaeocarpus sylvestris*）两种群有基本型聚集分布的特点并表现出个体间的聚集现象。橄榄（*Canarium album*）有可能随着密度的增大而趋于均匀分布。树种的空间分布格局依赖于其繁殖特性之外，还受该次生季雨林保护的影响。这些主要建群种的空间格局表明进行该林区保护的迫切性。

关键词：次生季雨林；空间格局；综合优势比；聚集指数

杉木与观光木混交林中细根的 N、P 浓度动态研究/杨玉盛，陈光水，谢锦升，李秀芳，陈银秀（福建农林大学，南平 353001）//Journal of Forestry Research. -2001, 12(2).-105-108

从 1999 年 9 月至 2000 年 7 月隔月应用连续土芯法对福建三明莘口林场杉木与观光木的混交林的细根进行取样并测定活、死细根的 N、P 养分浓度。结果表明，混交林中杉木，观光木和地下植被的细根的 N、P 浓度均与细根径级呈负相关。混交林中细根的 N 浓度大小顺序为观光木>林下植被>杉木，而 P 的浓度则为林下植被>观光木>杉木。混交林中杉木各径级细根的 N、P 浓度的动态变化表现为单峰型，在 9 月最高。观光木细根的 N、P 浓度的动态变化亦表现为单峰型，但 N 浓度高峰出现在 7 月或 9 月，而 P 浓度则在 5 月最高。

关键词：细根；杉木；观光木；混交林；氮；磷

吉林省森林生态建设面临的问题和对策/王宪成，徐程杨，刘福金，梁万军，韩国辉，张忠辉（吉林省林业科学研究院，长春市 130031）//Journal of Forestry Research, -2001, 12(2).-109-114

吉林省是我国重要林业省份，本文分析了吉林省生态建设现状和趋势，揭示了所面临的生态与经济问题。将吉林省划分为三个经济区：中西部农牧区、东部低山丘陵多种经营区和长白山国有林区。讨论了每个区的生态建设、发展方向和任务，并对该省的林业生态可持续发展提出了对策和建议。

关键词：吉林省；森林生态建设；可持续发展；森林资源；林业对策

红皮云杉人工林和天然林管胞性状的变异研究/任旭琴，王秋玉，李凤娟（东北林业大学，哈尔滨 150040）//Journal of Forestry Research.-2001, 12(2).-115-118

本文分别对凉水地区的红皮云杉天然林和帽耳山地区的红皮云杉人工林的管胞性状进行了研究，方差分析结果表明：管胞长度、管胞直径和管胞壁厚度在各年轮间都存在显著差异。管胞的性状从髓心到树皮都呈现出增加的趋势；天然林中，管胞各性状间存在显著的正相关；人工林中，管胞长度和管胞直径呈明显的正相关，但管胞长度和管胞直径分别与管胞壁厚度存在显著的负相关关系。天然林和人工林相比，管胞长度和管胞直径都没有太大差异，只是在 15 年生以前，人工林的管胞壁厚度稍大于天然林。

关键词：红皮云杉；人工林；天然林；管胞性状；变异

转基因杨树对美国白蛾幼虫中肠保护酶系统的影响/丁双阳（北京林业大学森林资源与环境学院 北京 100083），孟秀芹（辽宁省清原县林业局森保站， 清原 113300），李学锋（中国农业大学应用化学系，北京 100094）//Journal of Forestry Research.-2001,12(2).-119-122

以转 Bt 基因欧洲黑杨(*P.nigra* L.)和转 CpTI 基因毛白杨(*Populus tomentosa*)叶片饲喂 4-5 龄美国白蛾（*Hyphantria cunea* Drury）幼虫，对其体内保护酶系统活性进行测定。结果表明，饲喂两种转基因杨树叶片的幼虫中肠保护酶表现出相似的变化规律，SOD、CAT 和 POD 三种酶的活性在饲喂后数小时内逐渐增加，某一时刻达到最高值，此后突然下降。饲喂转 Bt 基因杨树叶片的幼虫，其中肠 SOD、CAT 活性峰值出现在饲喂后的 24 小时，POD 活性峰值出现在饲喂后的 12 小时；饲喂转 CpTI 基因杨树叶片的幼虫，其中肠三种保护酶活性高峰出现时间均较前者滞后 12 小时。本文还比较了饲喂两种转基因叶片不同中毒程度的美国白蛾幼虫体内保护酶活性，发现不论饲喂那种转基因叶片，中毒较轻者其体内保护酶活性显著高于中毒较重者，这种差异在饲喂 CpTI 叶片的处理株表现尤为明显。

关键词：转基因杨树；美国白蛾；保护酶

华北落叶松优树自然类型的划分/张新波，冯京华，任建茹（陕西省林业科学研究院，太原 00012）//Journal of Forestry Research,-2001, 12(2).-123-127

利用华北落叶松种子园优树无性系作为研究对象，根据形态特征，将其划分为 4 个自然类型：窄冠密枝型、宽冠密枝型、宽冠稀枝型和窄冠稀枝型。从聚类分析看出，各类型林木的生长差异极显著。通过近 10 年生长量对比，其优劣次序为：窄冠密枝型>宽冠密枝型>宽冠稀枝型>窄冠稀枝型.

关键词：华北落叶松；优树；自然类型

针叶林标准化地位指数在大兴安岭林区立地质量评价中的应用/谷会岩（东北林业大学森林植物生态开放研究实验室，哈尔滨 150040），杨凯（黑龙江省林业科学研究所，哈尔滨 150040），李春英，杨逢建（东北林业大学森林植物生态开放研究实验室，哈尔滨 150040）//Journal of Forestry Research.-2001, 12(2).-128-132

本文采用两点法原理和方法，对大兴安岭地区的落叶松和樟子松人工林地位指数表进行分析，建立了大兴安岭人工针叶林标准化生长模型，按模型导出各生长指数级和各龄阶理论值，并建立了标准化地位指数表。理论值检验结果表明，该标准化地位指数表符合精度要求。本项研究解决了大兴安岭地区针叶林同一立地类型不同树种地位指数和不同树种不同立地类型地位指数间的相互转换。

关键词：大兴安岭地区；人工针叶林；标准化地位指数

木材导温系数的理论表达式/杨庆贤（福建林学院，南平 353001），杨绮（厦门大学，厦门 361005）//Journal of Forestry Research.-2001,12(2).-133-135

本文从木材的化学组成和微观结构出发，从理论上推导出木材导温系数的理论表达式，应用该表达式计算 20 种左右木材弦向和径向导温系数，并与实验值对照，得出木材弦向导温系数与理论值的平均误差在 7.2%，木材径向导温系数与理论值得误差为 6.2%。

关键词：导温系数；理论表达式；木材

大兴安岭兴安落叶松林和针阔混交林物种多样性的对比/宋关玲（淄博学院，淄博 255000），杨国亭（东北林业大学，哈尔滨 150040）//Journal of Forestry Research.-2001,12(2).-136-138

本文运用 Simpson 多样性指数($D$)，Shannon--Wiener 多样性指数($H'$)，Pielou 均匀度指数($J_{sw}$&$J_{sj}$)，Alatalo 均匀度指数($E_a$)和物种多样性指数($S$)，对大兴安岭地区物种多样